

CALIFORNIA
AGRICULTURAL EXTENSION SERVICE

CIRCULAR 80

DECEMBER, 1933

BUSH BERRY CULTURE
IN CALIFORNIA

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Cooperative Extension work in Agriculture and Home Economics, College of Agriculture,
University of California, and United States Department of Agriculture cooperating.

Distributed in furtherance of the Acts of Congress of May 8, and June 30, 1914.

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THE COLLEGE OF AGRICULTURE
UNIVERSITY OF CALIFORNIA
BERKELEY, CALIFORNIA

CONTENTS

	PAGE
Importance of bush fruits	3
Trend of production	4
Cause of decline in berry production	4
The food value of bush fruits	5
Principal market outlets	7
Cost of producing bush fruits	8
Berries as an intercrop	10
Choice of a location	11
Blackberry varieties	13
Loganberry, Phenomenal, and youngberry	16
Dewberry varieties	17
Red raspberry varieties	18
Black raspberry varieties	20
Currant varieties	20
Gooseberry varieties	20
Methods of propagation	21
Red raspberries and upright blackberries	21
Trailing blackberries, dewberries, loganberries, youngberries, and black raspberries	21
Currants and gooseberries	22
Methods of planting	22
Blackberries, loganberries, youngberries, and dewberries	22
Raspberries	23
Currants and gooseberries	23
Cultivation	23
Irrigation	24
Pruning and trellising	25
Blackberries, loganberries, youngberries, and dewberries	26
Raspberries	31
Currants and gooseberries	32
Duration of plantings	33
Use of fertilizers	33
Common diseases	34
Blue stem, verticilliosis, or wilt (<i>Verticillium albo-atrum</i>)	34
Cane blight (<i>Leptosphaeria coniothyrium</i>)	34
Crown gall (<i>Bacterium tumefaciens</i>)	35
Fruit rot (<i>Botrytis</i>)	35
Leaf spot (<i>Mycosphaerella rubi</i> , <i>Septoria rubi</i>)	35
Mildew (<i>Sphaerotheca mors-uvae</i> and <i>S. humuli</i>)	36
Oak fungus (<i>Armillaria mellea</i>)	37
Redberry disease	37
Rosette	37
Spur blight (<i>Mycosphaerella rubina</i>)	37
Virus diseases of raspberries	37
Common insects and mites	37
Blackberry mite or redberry disease (<i>Eriophyes essigi</i>)	37
Currant borer (<i>Aegeria tipuliformis</i>)	39
Raspberry hornail (<i>Hartigia cressoni</i>)	39
Red spider (<i>Tetranychus telarius</i>)	39
Rose scale (<i>Aulacaspis rosae</i>)	39
Snowy tree cricket (<i>Oecanthus niveus</i>)	41
Miscellaneous insects	42
Harvesting	43
Brambles	43
Currants and gooseberries	45
Berry packages or containers	45
Distribution and marketing	47
Hauling and shipping bush fruits	47
Organization of berry growers	49
Outlook for bush fruits in California	49
Acknowledgments	51
References on bush fruits	52

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H. M. BUTTERFIELD²

IMPORTANCE OF BUSH FRUITS

Berry culture in California is one of the minor fruit industries. At the time of the last census berries were being grown on 8,345 California farms. Of this number, 5,025 farms were producing bush fruits, which include raspberries, blackberries, dewberries, loganberries, youngberries, gooseberries, blueberries, and currants. Table 1 shows the relative importance of the different kinds of bush fruits grown in California.

TABLE 1

PRODUCTION AND VALUE OF BUSH FRUITS AND STRAWBERRIES IN CALIFORNIA
(1930 CENSUS)

Berry	Crop value	Production, in quarts	Acres	Farms
Bush berries:				
Raspberries	\$ 524,235	2,966,139	1,185	1,185
Blackberries and dewberries	362,118	2,414,898	1,554	3,182
Loganberries	67,993	664,343	343	518
Currants	25,743	171,582	198	78
Gooseberries	10,643	106,417	77	39
Blueberries	90	602	1	23
Total, bush fruits	\$ 990,822	6,323,981	3,358	5,025
Strawberries	\$2,523,664	14,971,002	5,001	3,072

It will be seen from the above table that the average planting of bush fruits is small. In many cases the berry planting is limited to what can be grown and harvested without hiring outside labor. There is also a problem of finding a ready market for the crop at prices that will pay for the trouble. Occasionally a commercial grower will have from 5 to 20 acres of one of the bush fruits, such as youngberries or loganberries. In past years fairly large plantings were made, but most of these have now disappeared because of unfavorable market conditions.

The census figures do not indicate the present importance of youngberries. The acreage now devoted to this crop can only be estimated. A member of the organization committee of the Berry Growers' Association

¹ This circular supersedes Extension Circular 25, *Bush Fruit Culture in California*, by A. H. Hendrickson. Certain parts of Extension Circular 25 are quoted with permission of the author.

² Supervisor of Correspondence Courses in Agriculture.

in southern California estimated the commercial acreage of youngberries in the Los Angeles area, which includes Orange and Los Angeles counties and the western portions of San Bernardino and Riverside counties, at 350 acres early in 1933. Definite figures have not yet been gathered. Data supplied by the Federal-State Market News Service up to December 20, 1932, showed that 32,400 crates (30 half-dry-pint baskets each) of youngberries reached the Los Angeles market during the 1932 season. Of this total, 965 crates were shipped in from the north by express, some coming from the Watsonville district. There are many new plantings of the youngberry in the central California counties. The indications are that the youngberry now exceeds the loganberry in acreage and size of crop in southern California and that it may soon equal the loganberry in the northern counties.

TREND OF PRODUCTION

A knowledge of general trends in production is as important as a knowledge of present acreages, yields, and values. Blackberries and dewberries in California have continued to decline for the past thirty years, both in size of crop and in acreage. Fewer blackberries and dewberries are grown now than in 1899. The number of farms reporting raspberries has declined in the past ten years but the acreage and crop have increased, owing to important commercial plantings in central California. The loganberry crop has decreased but in large part has been replaced by youngberries. Currants and gooseberries have declined until they are of little commercial importance.

CAUSE OF DECLINE IN BERRY PRODUCTION

In seeking a reason for the decline in bush-berry production in California during the past ten years or more, it is necessary to compare the California crop with other states. The last census shows that California ranked third in the production of loganberries, fifth in the production of blackberries, currants, and gooseberries, and sixth in raspberry production, compared with other states.

The output of canned berries in Oregon and Washington has increased while the California output has declined. An investigation by Sulerud and Nelson³ for 1927 showed that Oregon and Washington together produced 49 per cent of the canned raspberries put up in the United States, nearly 100 per cent of the canned loganberries, 85 per cent of the canned blackberries, and 75 per cent of the canned gooseberries.

³ Sulerud, George Land, and Milton N. Nelson. Economic study of the small fruit industry of Oregon. Oregon Agr. Exp. Sta. Bul. 274:1-95. 1931.

Consumers have frequently expressed a preference for fresh strawberries and for other fresh fruits in place of the bush fruits. With fresh raspberries, loganberries, youngberries, and blackberries retailing at about 7½ to 10 cents for an 8-ounce basket, or at the rate of 15 to 20 cents a pound, many consumers have felt that other kinds of fresh fruit were more economical. But berries are often purchased because of their excellent flavor in spite of the relatively high cost.

Bush berries have not been very profitable in many cases. Sometimes yields are poor in certain locations, satisfactory labor is not always plentiful, and certain berry diseases and pests are hard to control. Home gardeners have continued to be interested in small fruits but even in this case production has been unsatisfactory where the berries were not given good care.

The blackberry mite, *Eriophyes gracilis*, has appeared in most California berry plantings to lower the quality of blackberries and occasionally loganberries. This pest renders a good part of the crop worthless unless prompt and effective control measures are practiced. Not all berry growers carry out such measures and naturally results are then unsatisfactory. This has brought about a reduction of acreage.

Excessive heat and lack of water for irrigation have also curtailed berry production on some farms in California. Desirable conditions for the grower of bush berries to seek are: (1) good soil; (2) plenty of cheap water for irrigation; (3) a favorable climate in respect to temperature and rainfall; (4) proper control of pests and diseases, and (5) ultimately a good consumer demand for the varieties of berries grown. If the growers could secure large yields at a low cost of production, then the consumer could buy berries at a lower price and demand would probably be stimulated.

THE FOOD VALUE OF BUSH FRUITS

The demand for any food product has much to do with its production and sale. Demand may be affected by sales endeavor on the part of producer organizations, as has been demonstrated many times. Such sales endeavor must be based on facts that will appeal to consumers. Producers and consumers of berries should have such facts as are now well established so that a fair and reasonable conclusion may be drawn as to the importance of berries in the diet.

Most people eat the various kind of berries because they appeal to the appetite. The flavor of berries is often far superior to that of other fruits consumed in large quantities. But the price per pound for berries is usually so much higher that the appeal of quality may give way

to the appeal of price. Nevertheless, there are some important facts which ought to influence consumers in the use of bush fruits. The flavor is of course important, but in addition the mineral and vitamin content should be considered.

Bush fruits are relatively high in mineral elements such as calcium, potassium, phosphorus, iron, and copper. Table 2 will show the relative amounts of these minerals present in bush berries and a few other fruits.

TABLE 2
MINERALS IN EDIBLE PORTION OF BERRIES AND SOME OTHER FRUITS

Fruit	Calcium	Potassium	Phosphorus	Iron	Copper
	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>
Blackberries.....	0.017	0.169	0.034	0.00090	0.00016
Blueberries.....	0.020	0.051	0.008	0.00090	0.00011
Currants (fresh).....	0.026	0.211	0.038	0.00063
Gooseberries	0.035	0.197	0.031	0.00050	0.00008
Raspberries (red).....	0.049	0.173	0.052	0.00088	0.00013
Strawberries.....	0.041	0.147	0.028	0.00068	0.00002
Apples.....	0.007	0.123	0.012	0.00036	0.00008
Oranges.....	0.045	0.177	0.021	0.00052	0.00008

Sources of data:

Calcium, potassium, phosphorus, and iron, from: Sherman, Henry C. Chemistry of food and nutrition. 614 pages. Macmillan Co., New York. 1932.

Copper from: Lindow, C. W., C. A. Eloehjem, and W. H. Peterson. The copper content of plant and animal foods. Journal of Biological Chemistry Vol. 82 (No. 2): 465-471. 1929.

It has also been determined that loganberries have more than 50 times as much iodine as apples and 14 times as much as peaches. In common with other fruits, the bush berries may be expected to supply some copper, which is needed in small amounts in the human diet. While fruits are not as high in copper as calf's liver, nuts, and certain other foods, they are well worth considering as a source of this mineral. Bush berries compare favorably in this respect with other fruits. It has been found that fruits which are acid before oxidation in the body aid in the absorption of calcium. Bush fruits are included in this group of fruits.

Berries are an important source of vitamins, especially vitamin C. This vitamin helps to prevent tooth defects and susceptibility to infectious disease. A deficiency of this vitamin may result in retarded growth, and fleeting pains in the joints and limbs, especially of children, and there may be poor complexion and a loss of energy. It is important to know that even after cooking, such berries as raspberries retain their efficiency of vitamin C to a very marked degree.⁴ This is not true of many popular fruits. Canned or preserved berries can be used to help maintain the supply of vitamin C during the time when fresh fruits or vegetables are scarce.

⁴ Sherman, H. C., and S. L. Smith. The vitamins. 575 p. Macmillan Co., New York. 1931.

In common with most fruits and vegetables, berries help to keep the body tissues neutral in reaction. For example, raspberry juice is even more alkaline when used in the body than orange juice and decidedly more alkaline than grape juice.

PRINCIPAL MARKET OUTLETS

The fresh-fruit market is the only important outlet for bush berries raised in California. A few berries have been shipped to the East but most of them are sent to the larger cities within the state.

California canneries packed no berries from 1927 to 1933, when some of the surplus youngberries were sold to canneries. It is very difficult for California berry growers to compete with other states in the production of canned berries. Past experience has shown that the outlet through canneries is not promising financially. Up to the present time the surplus left from the fresh-fruit market has been small and limited to a short period at the height of the season. A greater surplus than usual developed in 1933 so arrangements were made by the youngberry growers in southern California for canneries to take over the surplus. In the neighboring state of Oregon over three-fourths of the blackberries and gooseberries are disposed of through canneries, and almost the same proportion of loganberries. Nearly half of the red raspberries go to canneries in that state. This shows that canneries do put up a good pack under some conditions, but unless the price offered by canners in future years is better than in the past it is difficult to see how berry growers can afford to develop this outlet in California.

A few youngberries raised in southern California have been sold for frozen pack during each of the last few years. The demand for these frozen berries is still limited. With the introduction of the youngberry, California berry growers have an excellent bush fruit for frozen-pack purposes, since this berry is reported to hold up very well when frozen. But it would be exceedingly hazardous for a grower to freeze berries and then attempt to find a buyer. A contract should always be secured in advance for berries intended for the frozen pack.

The 1931 western frozen pack of bush fruits amounted to slightly over 15 million pounds. Raspberries led with 10,841,000 pounds, next in order came blackberries with 1,946,000 pounds, loganberries with 1,167,000 pounds, black raspberries with 740,000 pounds, currants with 276,000 pounds, and gooseberries with 52,000 pounds. These berries are usually held at a temperature not higher than 15° Fahrenheit.⁵

⁵ Directions for frozen pack may be found in: Joslyn, M. A. Preservation of fruits and vegetables in freezing storage. California Agr. Exp. Sta. Cir. 320:1-35. 1930.

COST OF PRODUCING BUSH FRUITS

Berry growers would like to anticipate cost of production in order to determine whether it will pay to plant or not. No general average for the state of California will necessarily indicate what may be expected in a particular locality. But there are certain factors that should be considered in any locality where berry growing is planned. Such figures as given below are intended to serve only as a partial guide in anticipating possible costs and returns in California.

Economy of production will depend on quantity of production per acre, quality of product, and efficiency in distribution and marketing. Production per acre may be considered first.

Yields as a Factor in Cost of Production.—Yields vary with the variety planted, the age of the planting, the soil, moisture conditions, climate, and the ability of the grower. County averages of blackberry yields have varied from less than 2,000 quarts, or 8,000 half dry pints (about 8 ounces each) to over 3,000 quarts (12,000 half dry pints) per acre, according to the last census. Average county yields for loganberries and raspberries are highly variable, ranging from less than 1,500 quarts (6,000 half dry pints) to over 4,000 quarts (16,000 half dry pints) to the acre. Red currants, which are most extensively grown in Alameda County, averaged 3,775 quarts per acre. County averages for gooseberries have ranged from 1,450 to 2,266 quarts per acre in the two leading counties. In all of these cases it will be seen that there is considerable variation. What the individual grower may hope for will depend on his own conditions, but he should try to secure above average in yields if he expects to have a profitable business.

Variations in yields for the local district should be determined in advance of planting as far as that is possible. Berry growers are faced with good and bad years like other fruit growers. There may be unfavorable conditions on the local farm which make it impossible to secure high yields. A study of the local conditions on the individual farm will often bring to light factors that have an important bearing on production. The following estimates of youngberry yields will illustrate the need for each grower to determine just about what he may expect to secure in the way of yields. The yields given in table 3 cover conditions on three commercial youngberry plantations established since 1925 in southern California. It will be noted that the low yield varies from 5,000 to 7,000 half-dry-pint baskets; high yields are estimated at 15,000 to 20,000 half-dry-pint baskets; and average yields for youngberries on these three farms varies from 9,000 to 12,000 baskets.

The yield of raspberries in southern California has been estimated at about 8,000 half-dry-pint baskets per acre for the Cuthbert while for Surprise a yield of 10,000 baskets is considered a good crop. In the Santa Clara County district an average yield of 2 tons, or 20,000 baskets, of the Ranere variety is expected. Black raspberries usually bear about 25 to 30 per cent less, but one commercial grower reported a crop of 12,000 baskets per acre in the second year. In the hot interior valleys yields of most varieties of raspberries will be lower than those just mentioned. The Van Fleet variety is being tested out in the hope that it will do better where the summer climate is very hot.

Very little has been said about blackberry yields in recent years. The Advance blackberry, grown for its early crop in southern California, the Crandall blackberry, and the dewberries, particularly the Gardena and Lueretia, produce from 6,000 to 10,000 baskets per acre over a period of years. In central California where the Lawton and the Himalaya have been the principal varieties, yields have ranged from 2 to 4 tons, or 16,000 to 32,000 of the half-dry-pint baskets per acre under favorable conditions. It is not unusual for Himalaya blackberries to yield from 6 to 8 baskets per hill per picking and 50 baskets for the season in the home garden with only ordinary care.

Expense Items for First Season.—With the present unsettled market conditions it is impossible to quote any set of figures which may be expected to prevail for any great length of time. The establishment of a berry farm where a value is placed on all labor used may involve the following items of expense:

Item	Estimated Cost per Acre in 1933
Rent.....	\$ 10 to \$ 30
Plowing and preparation of land (includes horse labor and use of implements).....	5 to 10
Berry plants, commercial varieties.....	20 to 40
Water for irrigation.....	15 to 40
Labor for setting out plants.....	4 to 7
Man and horse labor for cultivating and furrowing, and man labor for hoeing and irrigating.....	15 to 25
Posts and wire for trellis.....	35 to 45
Labor weaving vines on trellis.....	10 to 25
Spraying.....	3 to 6
Fertilizing.....	20 to 30
Total expense first season.....	\$137 to \$258

Harvesting Costs.—The labor cost for harvesting has declined rapidly in the last few years. Until about 1928 berry growers paid approximately 1½ cents a basket, or 18 cents for a 12-basket tray, for picking.

By 1932 the cost had dropped to about 1 cent a basket. The cost for the 1933 season is expected to be approximately $\frac{3}{4}$ cent a basket, or 9 cents for the 12-basket tray. At this rate a yield of 12,000 baskets would mean a picking cost of \$90 an acre.

Berry baskets (half dry pint) early in 1933 were quoted at \$3.15 to \$3.25 per thousand. The shook for the 12-basket trays was listed at 4 to 4½ cents. Nailing costs about 1 cent additional. With 1,000 trays per acre the cost would approximate \$50. The 30-basket crate costs about 25 cents. The 12-basket tray and the 30-basket crate are standard in southern California. In central California the large chest holding 120 of the

TABLE 3
ESTIMATED YIELDS OF YOUNGBERRIES IN HALF DRY PINTS PER
ACRE; 3 FARMS REPRESENTED

Farm	Low yield	High yield	Reasonable average
No. 1.....	6,000	15,000	12,000
No. 2.....	5,000	15,000	9,000
No. 3.....	7,000	20,000	12,000

half-dry-pint baskets is used extensively for local shipments. Both the chest and the 30-basket crate are returnable. The large 120-basket chest, holding 20 trays of 6 baskets each, was listed at \$3 to the grower before the berry season in 1933.

Size of Planting as a Factor in Cost of Production.—The proper unit for a commercial berry planting should be considered in connection with other farm work and market conditions. If there is danger of a serious surplus in the district without any satisfactory outlet, then the planting should be limited to family use or local sales. In view of the fact that commercial canneries have packed few berries since 1926 it may be difficult to develop an outlet through canneries.

One horse should take care of the work on about 30 acres of berries. On a smaller acreage either horse labor should be hired or else the horse used on neighboring farms to lessen the overhead expense. Hiring tillage work done is not always satisfactory because help may not be available at the proper time.

BERRIES AS AN INTERCROP

Bush berries are often used as an intercrop in young orchards until the trees begin to bear. Many California orchards have been started this way. Centers of berry production often change from district to district as newly planted orchards come into bearing. In many cases the

berries are removed as soon as the trees start to produce, largely because the owners develop a distaste for the somewhat irksome task of picking the berries. In some cases the interplanted berries may become infested with insect pests or diseases which makes their removal necessary even before the trees need all the available space. Interplanting young orchards with bush fruits is a desirable practice so long as the berries do not interfere with the best interests of the trees. As soon as the trees need the space the berries should be removed. In a few districts the berries have proved more profitable than the fruit trees, and in such a case the owner should decide whether he wishes to specialize in the tree fruits or in bush fruits and then devote all the space to the preferred crop.

CHOICE OF A LOCATION

The choice of a location for a berry planting is important for several reasons. In general, sites subject to late spring frosts should be avoided. Bottom lands or swales, into which cold air drains from the higher surrounding elevations, are often dangerous. A southern aspect is often thought to be desirable because of earlier ripening of fruit. Early berries usually command the best prices. Rolling or hilly land, while it may be free from frost, is generally somewhat more difficult to cultivate and irrigate than land which is nearly level.

As a rule, bush berries produce over a longer season in the cool coastal sections than they do in the warm interior valleys. Along the coast, some varieties produce two crops during a season, or tend to bear throughout the summer, but in the warm sections the picking season is much shorter. Bush berries are seriously injured by hot drying winds, especially if they are not irrigated frequently. Currants and gooseberries are often scalded by temperatures of 90° Fahrenheit or above.

An unfailing supply of water for irrigation is extremely important except in the few sections where berries are grown without irrigation. While some bush berries are comparatively deep rooted and seem to stand drought fairly well, others require rather frequent irrigation. The soil, during the growing season, must be kept sufficiently moist to keep the leaves turgid and the plants in a healthy vigorous condition. Lack of available moisture during the growing season results in weak, spindling canes and reduced fruit production the following year. If the plants are allowed to suffer for moisture shortly before or during the ripening season, the berries are inclined to be small and to crumble easily. Trouble with red spider is often serious in berry fields which are allowed to show the usual symptoms accompanying the lack of available moisture. Most bush berries are vigorous growers, spread rapidly, and

fill up the spaces between plants with new canes. Moisture to supply this large leaf surface must be supplied from a comparatively small volume of soil; hence, it is essential to irrigate at frequent intervals.

The brambles—blackberries, raspberries, dewberries, and loganberries—are adapted to a wide range of soils. Success with this class of fruits seems to depend more on the skill of the individual grower and on such other factors as site, suitable labor supply, and accessibility to market, than on the choice of any particular soil. However, most of the successful plantings are found on soils ranging from sandy loam to clay loam types. In general, the lighter types of soils are easier to handle, but the fruit is often small if not given proper cultivation and irrigation, while, on the other hand, the heavier types of soils, though harder to cultivate, produce larger crops.

Currants and gooseberries may be grown on fairly heavy soils and often flourish on soil which is wet for a considerable portion of the year. Soils which bake or become cloddy are rather difficult to manage because of the amount of cultivation and hoeing which is necessary.

Blackberries grown on soils having a high calcium content, or underlain with what is often locally known as marl, are frequently subject to a trouble known as "chlorosis," which is indicated by the light-yellow color of the leaves and by the reduced crop. Such soils should be avoided. The application of iron sulfate in furrows close to the plants aids in overcoming this chlorotic condition, but such treatment may not be economically feasible.

In the counties and districts in California where berries are grown extensively there is bound to be community interest. Facilities for marketing are usually available, though there is some danger of gluts on local markets during the peak of the producing season unless growers organize to regulate the distribution of the crop. It is to be assumed that the larger acreages in the special berry districts have developed because of favorable conditions for production and marketing, otherwise the plantings would soon have been replaced with other crops.

Sonoma County, particularly the Sebastopol section, still leads in the production of blackberries, according to the last census. But there has been a heavy decline in recent years, leaving plantings in the county probably less than 25 per cent of the 1920 acreage. Lawtons and Himalayas are still grown and a few replantings of Lawtons were put out in the last two years. Other counties leading in the production of blackberries and dewberries are: Santa Cruz, Los Angeles, and Tulare, according to the 1930 Census.

The heaviest plantings of loganberries occur in the counties of Santa Cruz, Los Angeles, Sonoma, and Monterey.

Youngberries are grown most extensively in the counties of Los Angeles, Orange, and San Bernardino, according to present estimates, but plantings are increasing in the northern counties.

The largest acreage of raspberries is found in the counties of Santa Clara, Los Angeles, Monterey, Santa Cruz, and San Mateo. These five counties have about 80 per cent of the state acreage of red raspberries.

Alameda County leads in the production of currants and gooseberries, but even there only a few acres are grown, mostly in the San Leandro-San Lorenzo district. Blueberries are reported only from Humboldt County, where acid soils are available. None of these three berry crops are of any great commercial importance in any county.

BLACKBERRY VARIETIES⁶

Advance.—Advance is a very early semi-upright blackberry suited to the milder sections near the coast in southern California. The berries are firm and valuable for early market, and free from blackberry-mite injury. There are two strains which should be interplanted to insure pollination. The variety is not recommended for central or northern California.

Brainerd.—Brainerd is a new variety resulting as a cross between the Himalaya and another variety, thought to be the Georgia Mammoth. George M. Darrow of the United States Department of Agriculture says that it is much larger and, under some conditions, better in quality than the Himalaya, also firmer. It is suitable for canning or frozen-pack preserving. It is being tested in this state and is worthy of further trial where the summer temperature is not too cool.

Burbank Thornless.—Burbank Thornless is mentioned here because it is often confused with and sold as the Cory Thornless. It has no prickles on the petioles of the leaves so can be readily distinguished. The flowers are borne late in the season in clusters like those of the Himalaya. This variety is of little value for any purpose. It bears fruit in a hot climate but the fruit is much inferior to that of the Himalaya. It is essentially the same as the wild thornless berry of Europe, from which it was probably developed.

Cory Thornless (Thornless Mammoth).—Cory Thornless is a thornless mutation from the Mammoth blackberry (fig. 1). It is an extremely vigorous, hardy, strong grower, and productive in good soil under good management, although a shy bearer under some conditions and also subject to injury by the blackberry mite. Canes are semitrailing, and occa-

⁶ The discussion of varieties of small fruits is confined to brief descriptions of the principal varieties now being grown and those considered worthy of trial.

sionally have thorns. The fruit is large, midseason, and sweet when ripe, but is inclined to be soft and difficult to handle, and is therefore not suitable for long-distance shipments, though popular for local markets. It is easy to handle and popular in the home garden because of the ab-



Fig. 1.—Fruiting branch of Cory Thornless blackberry.
(From Ext. Cir. 25.)

sence of thorns. Plants from root suckers or root cuttings revert to the thorny form.

Crandall (Macatawa).—Crandall is vigorous, hardy, very productive, and ripens fruit over a long season in the coast region, while in the interior valleys it is inclined to have a short season. The fruit is large, firm, and sweet, early in season, and a fair shipper. It is popular in the southern part of the state. The bush is somewhat tender, and the fruit is subject to attack by the blackberry mite.

Early Harvest.—Early harvest is a strong, upright grower, hardy, a good producer, and said to be self-fertile. The fruit is medium to small, sweet, of good quality; it is early in season, and ripens over a long period. The seeds are very small. The variety is susceptible to leaf rust. In California, it is limited to home plantings.

Evergreen (Oregon Evergreen).—The bush of the Evergreen is vigorous, strong growing, drooping, and perennial. The fruit is firm, sweet, of good quality, and large, although it tends to be small unless well supplied with moisture. It is late to very late in season. Although subject to injury from the blackberry mite, the variety is worthy of trial. There is a thornless form in Oregon known as the Thornless Evergreen which is very promising and apparently just as satisfactory.

Himalaya.—The bush of the Himalaya is extremely vigorous, very spiny, trailing or semitrailing, perennial, and a heavy producer. The fruit is roundish in form, of medium size, and juicy. The season is from June to late fall. It is a very popular variety, but is subject to redberry disease (blackberry mite). Plants bear well for many years, fourteen to twenty years in many cases.

Kittatinny.—The bush of the Kittatinny is a strong grower, hardy, and productive. The fruit is large, glossy black, sweet, and of good quality. It is midseason to late. The variety is very susceptible to red rust, and is rarely planted.

Kosmo.—This variety originated in Oregon and has been patented. It closely resembles the Mammoth and Cory Thornless but is reported to yield better than the latter. Until it has been further tested, little can be said about its commercial possibilities as compared with the Mammoth.

Lawton.—The bush is sturdy, erect, a strong grower, and a heavy producer. The fruit is large, black, sweet, of excellent quality, and midseason. It is a standard variety in Sonoma County, but is poor in quality unless fully ripe, and somewhat susceptible to rust. Broken roots sucker badly.

Macatawa.—The Macatawa is probably identical with Crandall or possibly an improved strain of Crandall.

Mammoth.—Mammoth was developed as a seedling along with the loganberry from the Aughinbaugh, a named variety of the wild Pacific Coast dewberry. The bush is extremely vigorous, fairly hardy, a rapid grower, and a heavy producer. The flower is considered partly self-sterile under some conditions. Canes are semitrailing or trailing. The fruit is very large, long in shape, black, sweet, and soft when fully ripe. It is very popular in California, ripening early to midseason, usually between the loganberry and the Lawton, and is often sold as a "black loganberry." The size of the berry tends to be small unless plants are

well cared for, and it is subject to injury by the blackberry mite. Some strains, possibly seedlings, seem to bear small fruit. There is a variety sold as "Seedless Blackberry" that probably developed in San Jose as a seedling of the Mammoth.

Texas Early.—This variety was introduced from Texas where it is well known. It resembles the Crandall in habit of growth but the berries average larger. The Crandall is sweeter, however. The Texas Early is promising in southern California where it is being grown.

LOGANBERRY, PHENOMENAL, AND YOUNGBERRY

Loganberry.—Canes of the loganberry (fig. 2) are vigorous, hardy, exceptionally productive, trailing in habit, and covered with a large number of rather small spines. Recent investigations indicate that the loganberry is just a form of the wild Pacific Coast dewberry and not a hybrid between the Auginbaugh and a red raspberry. The fruit is long, large, dark red in color, subacid in flavor, and good in quality. It is excellent for shipping or canning. The season is early. Loganberries are grown in nearly all berry sections of California. The bush is comparatively short-lived in some sections, and the fruit is too acid for some people.

A thornless form of the loganberry was discovered in Los Angeles County in 1929 and will doubtless become popular when placed on the market, since the plants bear well and are entirely thornless.

Phenomenal.—The vines are strong, vigorous, and productive. The fruit is large, long, red in color, subacid in flavor, larger than loganberry, but softer in texture; the drupelets are larger and more irregular. The variety is generally given the same culture as the loganberry; it ripens about a week later.

Youngberry.—The youngberry is a cross between the Phenomenal and the Mayes dewberry of the southern states. It is a vigorous grower and bears heavily. The canes are trailing. The fruit is large, dark red in color—almost reddish black when ripe—juicy, and sweeter than loganberry when fully ripe; the seeds are large. It ripens about the same time as the loganberry and is largely replacing the latter in some districts. It is excellent for fresh market and for frozen pack, but is probably not a substitute for loganberry in juice manufacture.

Many thornless forms of the youngberry have appeared, but most of these tested in California have been disappointing in yield or in other important characteristics. The Acme Thornless youngberry, a patented variety, is the most promising of the thornless type but needs further testing to fully determine its productiveness and resistance to disease.

Under some conditions it has appeared to be just as productive as the thorny type. A few acres of this variety are now under test so its commercial possibilities should be known within a year or two. Its future is very promising.



Fig. 2.—The loganberry is one of the best berries for pies, jams, jelly, and juice. It also has a good appearance on the market but is a little too sour as a fresh berry to please some people.

Another new berry seedling, resembling the youngberry but a little larger and later in season, is being tested out in southern California. It will probably be classed with the youngberry on the market and should be valuable in extending the season.

DEWBERRY VARIETIES

Gardena.—The Gardena is a vigorous grower and a heavy producer. The fruit is large, glossy black, firm, sweet, and delicious; the seeds are large. The season is early, about 10 days before the Lucretia. The va-

riety is popular in the southern part of the state. It is free from blackberry-mite injury.

Lucretia.—*Lucretia* is hardy and productive; the berries are large, sweet, black in color, and soft; the seeds are large. It ripens after the *Gardena*. It is a general purpose variety, self-fertile, and free from blackberry-mite injury.

Thornless Austin.—This variety is a thornless form of the *Mayes-Austin* type; it has been tested in California, but production has usually



Fig. 3.—The Cuthbert raspberry is popular throughout California. It is suitable for selling fresh, canning, or for frozen pack.

been poor and the plants have not been resistant to disease. The variety may appeal to the home gardener who can give it the good care required. This variety and the *Cory Thornless* are considered the best thornless trailing blackberries. The *Evergreen Thornless* may fill in as a later variety.

RED RASPBERRY VARIETIES

Cuthbert (Cassberry).—The *Cuthbert* (fig. 3) is hardy and a vigorous grower, with heavy foliage which protects fruit from sunburn; it is a heavy and regular bearer. The fruit is deep red in color, often too dark to please some people, large, conical, firm, separates readily from core, a good shipper, and well adapted for frozen pack. It is popular in all districts and, together with *Surprise*, accounts for about 90 per cent of the raspberry crop in southern California.

Latham.—Latham is a new eastern variety, vigorous, and very productive. It flowers late, and the fruit is late. The variety withstands drouth well; but the fruit tends to crumble under unfavorable conditions. The flesh is juicy, firm, usually good in quality, but occasionally poor. It is not promising for market but is suggested for further trial plantings in home gardens where there is an occasional drouth.

Lloyd George.—A new English variety, the Lloyd George, has become very popular in many parts of the United States. The plants are vigorous and productive, and have a good second crop. The fruit is early with a long season, very large in size, uniform and conical in shape, juicy, and of good quality. The variety is being tested out and is considered very promising commercially for local markets. It is a little soft for distant shipment but is recommended for further trial in home gardens or for sale to local markets. It must have good care if the fruit is to reach large size.

Ranere (Ranaree, St. Regis).—The plant of the Ranere is vigorous and hardy and sends up suckers freely. The berries are small to medium, bright red, and firm; the season is early and very long. The fruit is what is termed a "dry" berry and is an excellent shipper. This is the leading variety in the central coast region, such as in Santa Clara and San Mateo counties.

Surprise.—Surprise is one of the two most popular varieties in southern California. The canes are rather slender; the plant is hardy and bears early and through a long season (May 1 to June 15 in southern California). The berries are medium in size and of good quality; the variety is not a good shipper but sells well on the Los Angeles market, where earliness helps it to bring good prices.

Van Fleet.—A hybrid between the Cuthbert and *Rubus innominatus* from China, the Van Fleet was introduced by the United States Department of Agriculture. Plants are healthy and vigorous, even under dry conditions, and resistant to disease and heat. The fruit ripens late, is red but variable in color, softer than common red varieties, and falls readily from bushes when ripe. It has yielded from 5 to 10 quarts from a two-year-old plant. While this variety is not recommended for commercial purposes, it is worthy of trial in home gardens of the hot interior valleys where other raspberries are not successful. Plants should be set about 8 feet apart to give room for the large bushes. Propagation is by means of rooted tips.

BLACK RASPBERRY VARIETIES

Cumberland.—Cumberland is considered the best black raspberry for the Southwest. It has sold well on markets in southern California. The plant is vigorous and productive but normally yields about 25 per cent less than red varieties. The fruit is large, roundish conical, firm, and of good quality. The season is late and long.

Gregg.—Plants of the Gregg are strong, hardy, and productive. The berries, which mature in midseason, are medium in size, firm, and sweet. The variety is listed in central California for home and commercial planting. It is not of the highest quality, and plants are slow to develop.

Munger.—Munger is a stronger grower than Cumberland and is productive and a good shipper. The fruit is large and of good flavor. It is worthy of further trial, especially in southern California, but is somewhat subject to mildew.

CURRANT VARIETIES

Cherry.—The bush of the Cherry is fairly vigorous, hardy, medium in size, and a good bearer. The fruit is large, bright red, and borne in rather stout, well-filled bunches. Cherry is the leading variety in the central part of the state, but is somewhat subject to attacks of mildew and cane-borers.

Perfection.—Perfection is a new variety, grown very successfully in eastern and north Pacific districts. The bush is vigorous, healthy, strong-growing, and very productive. The berries are large, subacid, bright red, and borne on long well-filled bunches.

GOOSEBERRY VARIETIES

Champion (Oregon Champion).—The bush of the Champion is a strong grower and a prolific bearer. The berries are medium in size, smooth, roundish oval, and sweet when fully matured. Champion is resistant to mildew. It is the principal commercial variety in California.

Downing.—The bush of the Downing is vigorous, sturdy, and productive. The berries are medium to large, oval in shape, smooth and yellow sprinkled with red dots when ripe. The flavor is sweet and pleasant when fully ripe. This is a good market variety.

Houghton.—Houghton is one of the oldest varieties. The bush is strong growing, long-lived, and productive. The berries are small, roundish, dull red when fully ripe; the skin is smooth and thin. In season the

Houghton is earlier than the Downing. The chief disadvantage of this variety is the small size of the berry. It is resistant to mildew.

Poorman.—Plants of the Poorman are large and vigorous, very productive, and not susceptible to mildew. The fruit is large, oval, pinkish red when ripe; the quality is excellent. Poorman is one of the best varieties known. It has done well in Oregon in preliminary tests and is recommended for further trial in California wherever gooseberries are successful.

METHODS OF PROPAGATION

One important and favorable factor in growing small fruits is the ease and readiness with which a new planting may be started. New plants may be obtained from older plantings with but little trouble, or they may be purchased from a nursery at comparatively low prices. This factor is of special significance to the man of limited means just starting to grow fruit. Many of the brambles propagate naturally and abundantly of their own accord. Currants and gooseberries root readily from cuttings. The result is that new plantings may be set out, using older plantings already in existence as a source of supply, with no cost except for the labor of collecting and setting out. Plants secured in this way should be individually inspected before planting, to ascertain that they are not taken from diseased stock or stock infected with insects.

Red Raspberries and Upright Blackberries.—Red raspberries and upright blackberries may be propagated either by root cuttings or by suckers. The suckers, which appear wherever a root has been cut or injured, may be dug up and used as new plants, care being taken to secure a large portion of the roots. This method of obtaining new plants is very commonly adopted in this state and has proved thoroughly satisfactory. The common procedure of nurseries in securing plants by root cuttings is to dig up a number of old plants and cut the roots into short pieces, 3 inches or less in length. These roots are set out in rows in carefully prepared nursery soil. If not allowed to dry out and if given careful cultivation, they produce plants large enough to set out in one year from the time of making the cuttings.

Trailing Blackberries, Dewberries, Loganberries, Youngberries, and Black Raspberries.—Nearly all of the trailing varieties of blackberries, dewberries, youngberries, and loganberries, as well as the black raspberries, are usually propagated by tip layering. The method of obtaining plants in this way is to cover the end of the canes with a shovelful of earth during the latter part of the summer. The covered portion of the shoot sends down roots from the nodes and forms a plant that can be set out the following spring. Unless carefully handled, loganberry and youngberry tips are easily injured. For this reason some growers prefer

to use tips of these varieties which have been grown in the nursery row before being set out in the permanent planting.

Currants and Gooseberries.—New currant and gooseberry plants are usually obtained from cuttings or by mound layering. Gooseberries which do not grow readily from cuttings are easily propagated by mound layerage. Cuttings are made about 7 to 10 inches long from matured or ripened one-year-old wood. They may be cut at any time during the dormant season, and set out immediately in rows or stored in moist sand in a cellar or other cool place until spring. The cuttings are planted in nursery rows with one or two buds above the surface, care being exercised to see that the soil is firmly pressed around the buried portion. The resulting plants are grown in the nursery for one or two years. It is the practice in some sections of California to set these cuttings out in permanent form, instead of growing plants in the nursery row for a year.

METHODS OF PLANTING

Bush fruits are planted so that they may be easily cultivated in one or two directions. They are planted in hills or rows to conform to the growth of the plant and the nature of the site upon which they are set. The planting distance is governed by the ultimate size of the plants and convenience in cultivating and picking. Whenever practicable, these fruits should be set out early in the season, preferably not later than February. A larger number of plants survive when set out early than when set out in March or later. Gooseberries and currants start to grow very early in the season and should be planted as soon as the plants are mature or can be secured from the nursery.

The preparation of the soil for the new berry plantings should be as thorough as possible. On account of the shallowness of the feeding roots of small fruits, the effort expended in preparing the soil before planting will be repaid by the vigor and thrift of the young plants. The soil should be plowed deeply in time to allow the weeds and covercrops to decompose before the plants are set out, and should be made as fine and friable as possible by frequent harrowings. A mellow soil, free from lumps, enables the young plants to become established quickly and to survive the first year in greater numbers than is the case when the soil is carelessly prepared. During the first year, no special care is necessary for bush berries, as a rule, except to keep the young plants growing thriftily.

Blackberries, Loganberries, Youngberries, and Dewberries.—Blackberries should be set out not later than February or March in order to receive the benefit of the late rains. The plants ordinarily require but

little care in setting out. The long, slender roots are cut off, and the plants are placed at the depth at which they have been grown in the nursery. A hole is opened by a spade, the roots are spread out in a fan shape, and the earth is crowded firmly around them so that all portions of the root system come into immediate contact with the soil. The old stem is usually left to serve as a marker or guide in cultivating before the appearance of the new shoots from the crown. Instead of opening each hole with a spade or shovel, a furrow may be plowed along the row and the plants placed along the landside, and handled in much the same way as that just described.

Blackberries of an upright-growing habit, such as the Lawton, are usually planted in rows 6 to 8 feet apart, with the plants 4 to 6 feet apart in the rows. If planted in hills, they are usually set 6 to 8 feet apart each way. The trailing varieties, like the Mammoth and Cory, are planted in rows about 8 feet apart and are placed 8 to 16 feet apart in rows. Himalayas make a rank growth and should be planted somewhat further apart in the row than the Mammoth.

Loganberries, youngberries, and dewberries are trailing in habit and are spaced about the same as the Mammoth.

Raspberries.—No definite standard planting distance can be set for raspberries. The distances vary according to the variety and the district. If set out in hills, the plants are from 3 to 6 feet apart each way. If they are set out in rows, the rows are ordinarily 6 to 8 feet apart, and the rows themselves may be a solid mass of plants or may have the separate plants from $1\frac{1}{2}$ to 6 feet apart. Ordinarily the black raspberry requires more room than do the red varieties because it is more spreading in nature.

Currants and Gooseberries.—When planted in rows, currants and gooseberries are placed $2\frac{1}{2}$ to 5 feet apart in the rows, with the rows 5 to 6 feet apart. In hills, the plants are set on the square system, 5 or 6 feet apart each way.

CULTIVATION

Shallow cultivation is the practice with all small fruits. The feeding roots are comparatively near the surface and are destroyed by deep cultivation. With the brambles, a great many roots are broken by deep cultivation; this practice produces a large number of suckers in the middle of the row which must be cut out with a hoe. In other cases, an entire plant is often pulled out by catching the cultivator under one of the main roots. The land should be plowed in the spring, as shallowly as possible; but a clean furrow must be turned over to cover completely the trash and weeds or covercrop that may be on the ground. The plow-

ing should be followed by shallow cultivation, preferably with a light, fine-toothed implement, as often as necessary to prevent weed growth.

Bush fruits may be plowed deeper toward the middle of the row and more shallowly close to the plants. If the furrows are thrown away from the row, it is much easier to hoe out any weeds that may be growing in the row itself, while if the furrow is thrown toward the row, these weeds



Fig. 4.—Bush berries are irrigated in furrows close to the row. (From Cir. 164.)

are covered up, only to appear later in the season. Unevenness due to leaving the back-furrow or dead furrow in the middle of the row is easily remedied by a few cultivations. Another plan, adopted by many growers, is to harrow or disk the planting instead of plowing. This plan works satisfactorily if followed before the covercrop has reached such a size that it can be covered only by plowing.

IRRIGATION

An unfailing source of water is a requisite for growing bush berries; for these fruits, except in a few districts, are grown under irrigation. The practice, which is fairly well standardized, consists in applying water every two or three weeks until the berries begin to ripen; then the

irrigations are given more frequently, sometimes every four to seven days. After picking, the planting is irrigated every few weeks until late in the season, when the plants are allowed to mature and become dormant. Because frequent irrigation is necessary, the land must be carefully leveled and graded before planting, in order that the water may be applied evenly and economically.

The water is applied in furrows on both sides of the row (fig. 4). This practice leaves a high middle portion between rows which remains dry and serves as a place for the pickers to stand. If a comparatively large head of water is used, the furrows are large, from 200 to 300 feet long, and are laid out on a grade nearly level. The furrows are filled level full with water. When a smaller head of water is used, the grade is sufficient to permit the water to reach the lower end, and the water is allowed to run for a longer time. Very often when the row becomes wide and filled with canes because of the unchecked growth of suckers, the central portion is not wetted by the ordinary irrigation. There is a tendency on the part of many growers to hurry the water from one end of the furrow to the other and then to consider the work done. During the hot weather, bush berries use a tremendous amount of water, most of which is taken from the upper 2 or 3 feet of soil. Exhaustion of moisture in this area is quickly shown by wilting of the leaves and shriveling of the fruit. Lack of moisture during the growing period materially shortens the picking season and reduces the crop.

PRUNING AND TRELLISING

Blackberries and raspberries produce fruit usually but once on a cane of one season's growth. The canes necessary for the bearing of the crops are produced during one season, flower and bear fruit during the next, and must then be removed. As soon as the canes have borne a crop of fruit, their usefulness ends, and they usually die before winter. A few varieties, such as the Himalaya and the Evergreen blackberry, have perennial canes, but the pruning of these varieties is not essentially different from that given the varieties having the canes which live for only two years. Since the perennial canes are often infested with rose scale, it is desirable that they be replaced by the younger growth. On the other hand, certain varieties of raspberries, like the Ranere, bear fruit during the *first* season at the ends of the new canes. These ends which have fruited should be cut off at the regular pruning time.

The aim of the grower in pruning should be to accomplish two things: first, to cut off the tips of the new canes, if they have already borne fruit and to remove the old canes which are of no more value to the plant; and

second, to provide a supply of new shoots for bearing fruit the following season. New canes should not be left too thick. Wider spacing produces tall canes and thereby facilitates picking.

Blackberries, Loganberries, Youngberries, and Dewberries.—Blackberries are pruned in such a way that they may be tied to wire trellises



Fig. 5.—Crandall blackberry before pruning. (From Ext. Cir. 25.)

or to stakes, or trained to grow upright without support of any kind. The varieties that trail, or produce long runners that naturally lie on the ground, are trained to wire stretched on posts, and the stronger, upright-growing varieties are tied to stakes or pruned short so that they are able to support their own weight (figs. 5 and 6). The length of the canes left to produce the following season's crop varies considerably with the variety and with the practice found best in different sections. Strong-growing varieties like the Lawton and Crandall are usually

pruned back to 3 or 4 feet. Trailing varieties like the Himalaya, Brainerd, Mammoth, Cory, loganberry, and youngberry, are cut back leaving 8 to 16 feet, according to the distance between the plants. It is a good practice to tip back or cut off the ends of the growing shoots during the summer, as soon as they have reached the desired length.

New canes to replace the old ones removed after fruiting come up as suckers around the crown of the plant. More of these suckers are pro-



Fig. 6.—Same plant as in figure 5, after pruning.
(From Ext. Cir. 25.)

duced than should be allowed to grow. For most varieties, from 4 to 7 healthy new canes should be left to each hill and all small or inferior ones cut off close to the ground. This thinning of canes can be done during the early growing season. All canes cut off should be removed from the plantation and burned as soon as practicable.

A special pruning system has been developed for the youngberry. During the last five years many commercial growers have cut off all canes on youngberry plants, both old and new, just as soon as the crop was off. Since there are no important shipments after July 1 these growers have cut off all youngberry canes about this date. In a warm climate and with good soil conditions vigorous plants would grow suffi-

cient new canes to produce a good crop of berries the next season. This practice is doubtless very weakening and is objectionable in any district where soil and climatic conditions are not favorable for late-season growth. Prolonged dormancy, or delayed foliation, which has been troublesome in some of the counties with a mild winter climate, may be due in part to excessive stimulation through such pruning, though in the opinion of large commercial growers, the saving in the cost of pruning easily justifies such severe summer pruning. All new canes which



Fig. 7.—Loganberries tied to a single wire trellis. The young shoots are allowed to grow under the row during the first season. (From Cir. 164.)

develop after the topping should be left on the ground to keep them cool, thus aiding in preventing prolonged dormancy in the spring. The canes can be raised to the trellis just before new growth starts in the spring.

After the first growing season, trailing varieties are trained to one or two wire trellises. When one wire is used, it is stretched along stakes in the row at a height of $2\frac{1}{2}$ or 3 feet above the ground, and the canes are wound about it or tied to it (fig. 7). Another method which has proved successful is to use a two-wire trellis and weave the canes around both wires in a loose spiral. The canes should be spread on the wires (fig. 8), and not twisted together like strands in a wire cable. The new canes that grow during the summer are allowed to lie on the ground under the row during the growing season. During the winter pruning, the old canes

are cut and pulled off the wire, and the new canes are brought up and tied in their place. In another two-wire system, the lower wire is 2 to 3 feet from the ground and the upper one $1\frac{1}{2}$ to $2\frac{1}{2}$ feet above the lower.



Fig. 8.—Trailing varieties are often woven around the trellis wires in loose spirals.
(From Cir. 164.)

The young canes are trained to the upper wire, and the bearing canes to the lower. This method provides shade for the fruiting canes and aids in producing berries of large size.

Loganberries, the Phenomenal berry, youngberries, and dewberries are trained in the same manner as trailing blackberries. The general practice in many sections has been to train these varieties on a single



Fig. 9.—Cory Thornless blackberry before pruning. (From Ext. Cir. 25.)

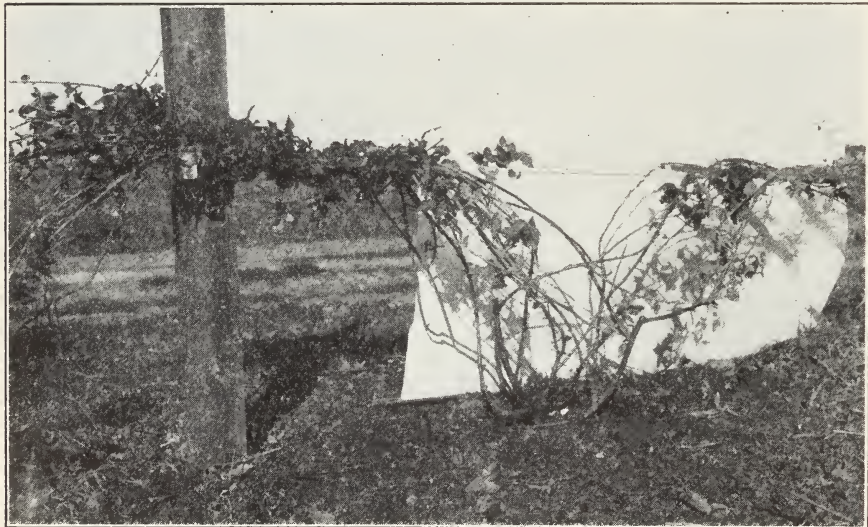


Fig. 10.—Cory Thornless blackberry after being pruned and placed on the slats in a two-wire trellis. (From Ext. Cir. 25.)

wire, extending the canes along the wire either in one or in both directions from the crown of the plant.

No. 14 gauge galvanized wire is used for raspberries and dewberries, and No. 12 gauge for the heavy-growing sorts like Himalaya.

Another method of training adopted for some of the trailing blackberries is to use a two-wire trellis, the wires being fastened to the ends of short cross arms nailed to the posts. The canes are supported by slats



Fig. 11.—Raspberries partially supported by two wires stretched between short cross-arms on the stakes. (From Cir. 164.)

resting on the wires, and but little tying is necessary (figs. 9 and 10). This method is sometimes used with the Himalaya, but unless this variety is thinned out severely each year, there is such an impenetrable accumulation of canes that only a portion of the berries can be picked. Moreover, thorough spraying of these hedge rows is difficult.

Raspberries.—Both the red and the black varieties of raspberries are for the most part trained to stand alone. In some cases, when varieties are drooping in nature, or when a rank, heavy growth is produced, posts are set along the row, and short cross-arms, 18 or 20 inches in length, are nailed at a convenient distance from the ground, usually $2\frac{1}{2}$ to $3\frac{1}{2}$ feet. Wires are stretched from post to post at the end of these

cross arms. The plants are pruned so that they grow up between these wires (fig. 11) and are supported by them, and, as a rule, no additional tying is considered necessary. Some varieties of blackberries may also be trained to this system. By means of short cross-pieces fastened to the wires, a number of different methods of training may be devised to suit local conditions.

Raspberries produce their fruit in the same manner as do blackberries: hence, the old canes must be removed after fruiting. This work is usually done immediately after the early summer crop. During the dormant season the plants are thinned, leaving 3 to 7 canes in each hill. The canes are cut off about 3 to 4 feet above the ground, according to the nature of the growth and the training system followed. Weak-growing varieties without supports must be cut back more heavily than the sturdier kinds. Large numbers of suckers spring up from the roots of red raspberries, and, unless it is desired to have a more or less solid row, these suckers must be grubbed out with a hoe, and the plants maintained in single units. New canes of the *Ranere* raspberry should not be cut back too heavily during the winter pruning, for the early fruits are produced near the ends of these canes. The tips of young raspberry plants should be pinched out when the canes are up about 12 inches. This will encourage branching and is especially recommended for the *Surprise* variety. Some growers cut back the new canes to 1 foot from the ground about May 1, or just before picking starts.

Currants and Gooseberries.—Currants and gooseberries must be treated in an entirely different manner from that described for the brambles. Their growing habit and method of bearing fruit must be carefully studied in order to prune them correctly. The bushes are more compact in form and are treated more like tree fruit than are the brambles. New wood is produced both by the branching of existing limbs and by suckers that come up from the root. These suckers, however, come up near the crown of the plant and not promiscuously from the roots as in the case of some of the raspberries. The larger portion of the fruit is borne on short spurs on the two and three-year-old wood, a smaller amount being produced on the four and five-year-old wood. The pruning consists in removing the three and four-year-old wood, which is easily distinguished by the dark color, and in thinning out the new shoots when they are too thick. Ordinarily from 3 to 5 old stems are removed each year and an equal number of new shoots are left at pruning time.

DURATION OF PLANTINGS

Small fruits come into bearing early, reach their maximum production in from 3 to 5 years, and then begin to decline. Very few of the bush fruits remain profitable after 8 or 10 years, although some varieties like the Lawton produce satisfactory crops up to 20 or 25 years. Himalaya blackberry plantings have borne good crops for 14 years. For Lawtons and Mammoths, 10 and 12 years are not uncommon. In some districts, loganberries die out in 4 to 6 years; in others, they are productive for a longer period. The presence of one or more diseases in a field often makes it advisable to plow up and burn all the old plants and start over again rather than attempt to eradicate the trouble in the existing planting. The rosette disease of the loganberry has practically limited the life of this variety to 4 years in Sonoma County.

Certain varieties of raspberries, like the Ranere, often produce a few berries the same year they are planted, and usually bear a profitable crop the second season. Blackberries usually produce a few berries the second season after planting, reach their maximum production in from 3 to 5 years, and are ready for removal in from 7 to 10 years, according to the character of the soil and the care given the plants. Loganberries and youngberries often produce fairly heavy crops the second season after planting and should remain profitable for a number of years, if disease is controlled. Currants and gooseberries ordinarily do not produce crops until the third year, are at their best in from 3 to 6 years, and are removed in 9 or 10 years.

USE OF FERTILIZERS

Although fertilizers of various kinds are often used with bush berries, there is little or no experimental evidence in California concerning the benefits of this practice. Bush berries are nearly always grown under methods of soil management similar to those used in growing vegetables, the fertility of the soil being maintained by the use of animal manures. It seems desirable to have the soil fairly well supplied with organic matter before setting the plants. During the succeeding years, it is generally the practice to fertilize with applications of from 10 to 20 tons of barnyard manure to the acre, when this material is obtainable. Some growers make a practice of adding manure at irrigation time, so that it can be shoveled into the irrigation streams and distributed by the water. Chicken manure is often composted with strawy material before using.

Evidence from experiment stations in other states seems to indicate that nitrogenous mineral fertilizers are beneficial when applied to rasp-

berries which are making weak growth and producing poorly. With blackberries the use of nitrogenous mineral fertilizers seemed to give negative or inconclusive results.

Legumes are often recommended for covercrops to supply nitrogen and vegetable matter to the soil. These crops should not be allowed to grow too late in the spring because of the difficulty in getting them plowed under when allowed to grow too rank.

COMMON DISEASES

There are several serious diseases injurious to berry plants which will lower yields and quality and in some cases greatly shorten the life of the planting. The heavy annual pruning to which berries are subjected, in which the old wood and such new shoots as may show signs of disease or insect injury are removed, serves to hold some of these troubles in check. The comparatively frequent removal of the planting also serves to prevent the permanent infestation of a given piece of ground. In many cases it is cheaper to pull out the old plants and reset with healthy ones in a new location than to combat insects or fungus diseases by spraying or by other preventive measures. On the other hand, certain troubles can be controlled only by spraying.

Blue Stem, Verticilliosis, or Wilt (Verticillium albo-atrum).—Raspberries, particularly the Ranere, are susceptible to blue stem. This disease is characterized by a stunting and killing of new canes, by loss of lower leaves, and finally by an intense blue discoloration of the canes. The blade of the diseased leaf falls first, leaving the petiole, which does not drop until several weeks later. In the last stages, only a small tuft of leaves remains at the tip of the infected canes. The disease enters the plant through the roots. No specific control measures are known. Diseased plants should be removed and burned. New raspberry plantings should not follow tomatoes or potatoes when *Verticillium* wilt is known to have been present.

Cane Blight (Leptosphaeria coniothyrium).—Youngberries in southern California are more or less generally affected by cane blight. Diseased plants decline in yield and the berries are smaller. In some cases the berry plants have had to be dug out after the second season. In the form of cane blight attributed to the fungus *Leptosphaeria coniothyrium*, dead areas of brown color appear on the canes; in many cases the diseased area girdles and kills the canes. In at least one case diseased canes examined by the Division of Plant Pathology developed the fungus *Mycosphaerella rubi* (*Septoria rubi*), the well-known leaf spot disease of berries. No successful method for control has yet been reported

for *Leptosphaeria* cane blight, though the application of winter-strength bordeaux mixture or lime-sulfur has been suggested. Apply just as the buds are swelling. Three other applications about 10 days apart, using summer-strength bordeaux mixture, have been recommended for further aid in control. It is well to remove and burn all diseased canes immediately after the crop is harvested in June.

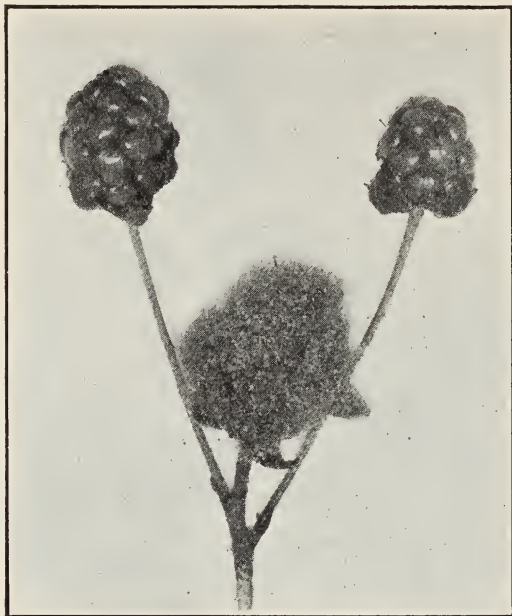


Fig. 12.—Fruit rot of blackberry (*Botrytis vulgaris*); also attacks loganberry and occasionally other bush fruits. (From Bul. 218.)

Crown Gall (*Bacterium tumefaciens*).—One of the most serious diseases of the brambles with which the grower must contend is crown gall. This is a bacterial disease forming a warty growth on the roots and may ultimately cause the death of the plants. This disease can be held in check only by setting out clean stock when making new plantings and by removing and burning old plants which are infected in the older plantings.

Fruit Rot (*Botrytis*).—The ripe fruit of blackberries and loganberries decays on the bushes. Later a grey, dusty mold appears (fig. 12). The trouble occurs mostly in moist weather and on berries that may remain wet with dew or rain for some time. Spreading out the canes so the berries will dry off quickly is about the only feasible treatment.

Leaf Spot (*Mycosphaerella rubi*, *Septoria rubi*).—Small dead spots

occur on the leaves and canes, with brown or reddish borders (fig. 13). The disease may be severe on Mammoth, Cory, wild dewberry, and loganberry. The fungus has also been isolated on the canes of youngberries. The control methods suggested for cane blight may be applied where the disease seems to warrant the expense.

Mildew (*Sphaerotheca mors-uvae* and *S. humuli*).—Currant and gooseberry plants are often infected with a mildew, *Sphaerotheca mors-*



Fig. 13.—Leaf spot of blackberry (*Mycosphaerella rubi*).
(From Bul. 218.)

uvae, which forms a whitish, powdery growth on the new leaves and shoots, reducing the vigor of the plants and ultimately decreasing the crop. Another powdery mildew, *Sphaerotheca humuli*, severely attacks the fruit and foliage of raspberries at times. The infected shoots of currants, gooseberries, and raspberries should be cut off and burned during the pruning season. A dormant spray of lime-sulfur (1 to 10) has been recommended. Raspberries may be burned with sulfur dust and summer strength lime-sulfur; these materials are therefore considered unsafe for treating mildew or red spider on raspberries. The refined summer oil emulsions may give some relief if applied early. Further tests are needed to find a safe and effective treatment for mildew on bush fruits.

*Oak Fungus (Armillaria mellea).*⁷—In some districts brambles become infected with oak fungus. There is no remedy for this disease. As soon as the plantation is decimated so that it is no longer profitable, it should be plowed out. Removal of near-by plants may help check the spread of the fungus.

Redberry Disease.—See "Blackberry Mite," below.

Rosette.—Rosette is a name applied to a stunt disease of the loganberry in Sonoma County. It may be a virus disease, but the exact cause is undetermined. No control is known.

Spur Blight (Mycosphaerella rubina).—Canes affected by spur blight bear fruit only near the tips. Early in the season the diseased tissue about the base of the bud turns brown, and the bud stops growing and shrivels up. The entire lower part of the cane may become dark purplish brown. A weak bordeaux, 3-2-50, plus 2 pounds of resin fish-oil soap, has been recommended for control. Make the first application when the young canes are 8 to 12 inches high and the second two weeks later. Treat only the young canes.

Virus Diseases of Raspberries.—For many years eastern growers of raspberries have been troubled with certain virus diseases. C. W. Bennett discusses them as follows:

There are apparently at least five distinct virus diseases of raspberry. The names curl, red raspberry mosaic, mild mosaic, yellow mosaic, and streak have been used to designate these troubles. With the exception of streak, all of these diseases have been transmitted by means of aphids. . . . The most satisfactory control measures for virus diseases available for general use are: (1) careful and efficient roguing and (2) selection and production of virus-free nursery stock.⁸

As yet these virus diseases are not known to be established in California, but with the free introduction of eastern raspberry plants there is considerable danger unless only virus-free nursery stock is planted. Great caution in buying raspberry plants outside of California is suggested.

COMMON INSECTS AND MITES

Blackberry Mite or Redberry Disease (Eriophyes essigi).—The Himalaya, Cory Thornless, Mammoth, Evergreen, and Crandall blackberries, and occasionally the loganberry, are affected by the blackberry mite, a microscopic arachnid pest. Blackberries attacked by this mite grow to approximately full size, but do not mature, all or part of the drupelets

⁷ For a further discussion of this disease see: Hendrickson, A. H. Oak fungus in orchard trees. California Agr. Exp. Sta. Cir. 289:1-13. 1925. (Out of print.)

⁸ Bennett, C. W. Virus diseases of raspberries. Michigan Agr. Exp. Sta. Technical Bul. 80:1-80. 1927.

See also: Rankin, W. Howard. Mosaic of raspberries. New York Agr. Exp. Sta. [Geneva] Bul. 543:1-60. 1927.

remaining red and hard (fig. 14). Drupelets of the loganberry remain a yellowish green instead of turning dark red. The injured fruit is unsaleable and has little value for home use. Control has been effected by applying a spray consisting of 4 to 8 gallons of lime-sulfur solution to 100 gallons of water, when the leaf buds are beginning to open in Feb-

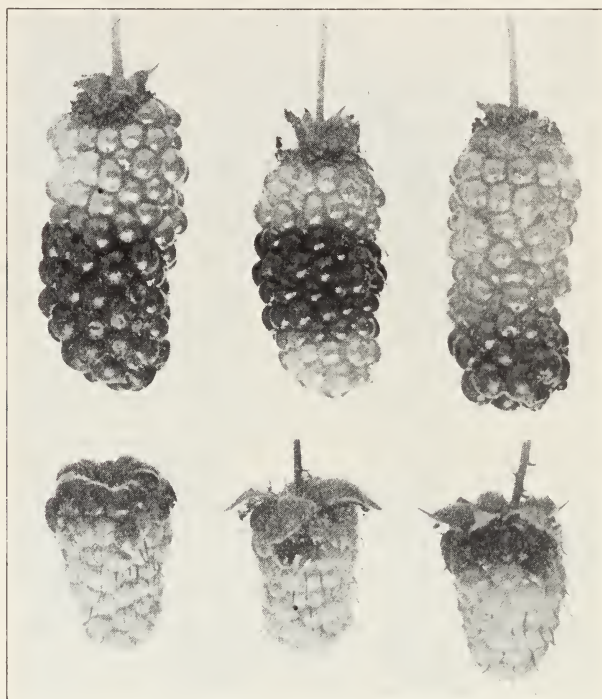


Fig. 14.—The blackberry mite attacks the late varieties of blackberries and occasionally loganberries, causing blackberries to remain red and loganberries a yellowish green. The drupelets do not mature normally but become hardened so that the affected fruit is worthless. The upper berries shown are Cory Thornless blackberries; the lower ones are loganberries. The lighter-colored portions are affected with the blackberry mite. (Berries are natural size.)

ruary or March. Summer control may be obtained by spraying with summer oil or refined oil emulsions. Thorough coverage is only possible when the canes are properly thinned out in pruning and training. The Advance blackberry and the dewberry varieties such as the Gardena and Lucretia, have so far escaped injury. These early varieties may be planted where the blackberry mite is serious. Early blossoming does not fully explain this freedom from attack, however, because even the late fruit escapes attack, while nonresistant varieties blossoming at the same time are badly infested.

Currant Borer (*Aegeria tipuliformis*).—Currants and gooseberries are injured by the currant borer. This insect works in the heartwood of the branches or stem of the plant. These parts are either killed or injured to such an extent that they break down under the weight of the fruit. The only remedy is to watch carefully for its work and remove and burn all infested parts when pruning.

In some districts currants are also attacked by the flat-headed apple borer (*Chrysobothris mali*).

Raspberry Horntail (*Hartigia cressoni*).—Raspberries, and sometimes loganberries and Himalaya blackberries, are often attacked by the raspberry horntail (fig. 15), the larvae of which girdle the tips of

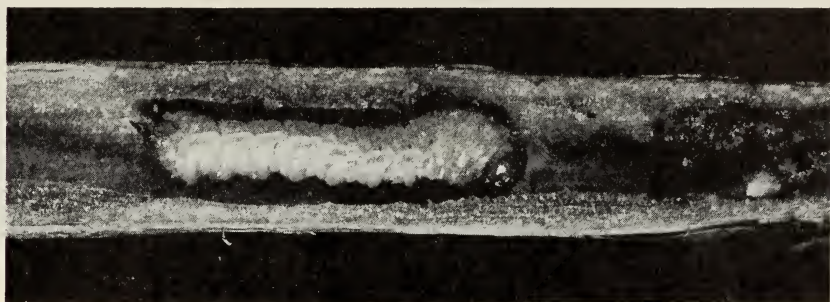


Fig. 15.—Mature larva of the raspberry horntail, which seriously attacks the young canes of the blackberry, loganberry, and raspberry. (From Bul. 505.)

tender new shoots, and cause them to wilt. The wilted canes should be cut out a few inches below the evidence of wilt and burned.

Red Spider (*Tetranychus telarius*).—One of the most serious pests on the brambles is a minute, pale greenish yellow mite with two dark spots on its back, commonly known as red spider. It is known by a number of names, such as the two-spotted mite and summer mite. It appears in early summer and does great damage to raspberries by causing the leaves to fall and the fruit to shrivel and dry. This pest spins webs on the underside of the leaves, where the eggs and adults may be seen in all stages of development. It feeds upon the foliage of the plant, sucking the juice. As it overwinters in the adult stage in debris, there is no way of control by spraying until it begins to appear with the approach of warm weather. Different forms of sulfur have been used to control this pest on tree fruits, but when tried on raspberries severe burning of the foliage usually results. Sulfur is not a safe remedy for red spider, either on bush berries or on strawberries. The most promising spray for this pest is a 2 per cent summer-oil emulsion.

Rose Scale (*Aulacaspis rosae*).—Rose scale is occasionally found on the canes of blackberries and raspberries. Ordinarily the winter prun-

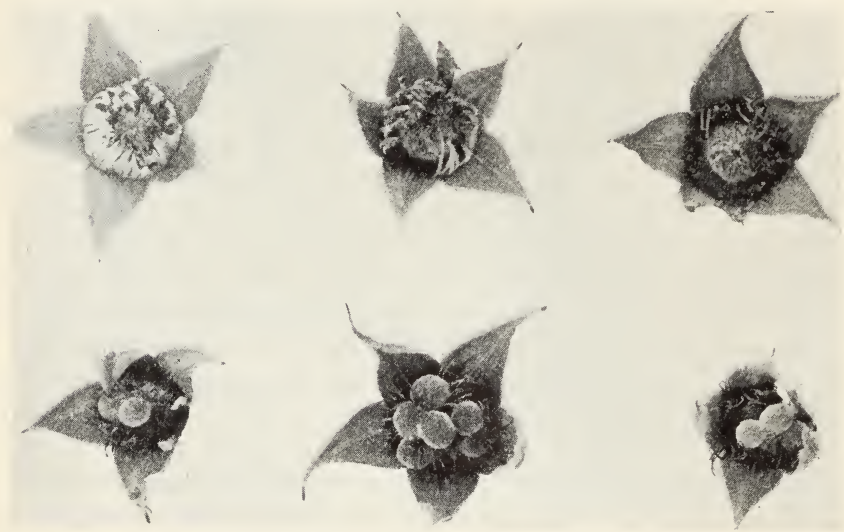
*A**B*

Fig. 16.—*A*, The snowy tree cricket on a raspberry leaf. *B*, The damage done to the berries. (From Bul. 505.)

ing serves to hold this insect in check, but in case of severe infestation the berry plants should be sprayed in the winter with a distillate emulsion or lime-sulfur solution.

Snowy Tree Cricket (Oecanthus niveus).—The snowy tree cricket (fig. 16) has been doing considerable damage to raspberries in the Santa



Fig. 17.—Larva of the strawberry crown moth, in burrow of raspberry crown. (From Bul. 505.)

Clara Valley for the last few years. The injury is chiefly due to feeding on the parts of the flower, which results in deformed, worthless berries, or none at all. Leslie M. Smith,⁹ who has studied this insect, has found that a dust containing 70 per cent sodium fluosilicate applied at the rate of 50 pounds to the acre gives complete control in five to ten days. The dust is poisonous to man, and no berries should be picked for two

⁹ Smith, Leslie M. The snowy tree cricket and other insects injurious to raspberries. California Agr. Exp. Sta. Bul. 505:1-38. 1930.

weeks after dusting. The best time for application is between the early summer and late summer crops.

Miscellaneous Insects.—Occasionally a very small worm attacks the fruit of loganberries near the core at the base end. An application of 40 per cent nicotine sulfate, 1 part to 600, may be sufficient for control where the worms are numerous. No exact identification of this insect has yet been made.



Fig. 18.—Damage of the strawberry root worm to raspberry leaves. (From Bul. 505.)

A small predacious red mite is sometimes gathered with raspberries. While the mites are in no way injurious, they are objectionable to consumers and cut down sales. Washing the berries would probably remove most of these insects.

The blue sharpshooter (*Cicadella circellata*), Fuller's rose weevil (*Pantomorus godmani*), strawberry crown moth (*Synanthedon bibionipennis*) (fig. 17), and strawberry root worm (*Paria cancella* var. *quadrinotata*) (fig. 18) are among the insects which may occasionally attack raspberry plants. The strawberry root worm has continued to be an important pest. The strawberry crown moth and raspberry crown borer are usually injurious only on plants that are growing in light, dry soil. Fuller's rose weevil has increased in the last few years.

HARVESTING

Berries are among the most perishable fruits grown on a commercial scale, and cannot be handled in the same way as even the tender kinds of tree fruits. The length of time between the attainment of maturity, when they are of highest quality for table use, and the beginning of deterioration is very short. The perishable nature of this class of fruit necessitates extremely careful handling, prompt shipping, and immediate consumption. No class of fruit has better flavor or quality when at the

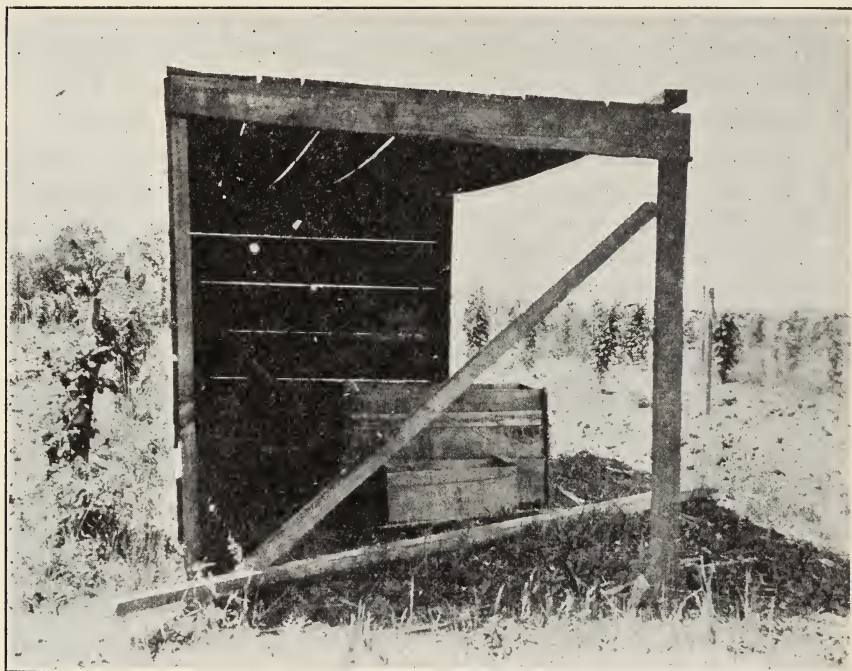


Fig. 19.—An inexpensive shed to protect the picked berries from the sun.
(From Cir. 164.)

proper stage of ripeness, or decays more quickly when not properly handled. If the tender skin of a few berries is injured so that the juice runs out, this fruit is quickly infected with various molds or rots, and the contents of the entire container may be unfit for use within 24 hours.

Brambles.—The brambles should be picked often during the height of the season. During the early part of the picking season, the patch should be picked every three or four days; but when the berries begin to ripen faster, the entire patch should be picked each day. Blackberries should

not be picked until the little depression in the center of each drupelet is entirely filled.

Berries should be picked directly into the box or cup in which they are sold, and should not be handled by regrading or sorting. The marketable grades should be picked directly into the market packages, and soft fruit either picked into a separate receptacle or dropped on the ground. Berries crushed in picking should not be mixed with the sound fruit. The picked fruit should not be left standing in the sun, but should be placed in the shade under a tree or shed (fig. 19). No berries should be picked when wet from rain or fog. All fruit should be taken to market or shipping station as soon after picking as possible.

The use to be made of the berries determines the exact stage of ripeness at which they should be picked. Generally speaking, raspberries may be used for local or nearby markets when they separate from the "core" without crumbling or falling apart. For long-distance shipments, only the firmer berries should be used, while the softer grades are utilized for canning. Blackberries, loganberries, and other brambles in which the berry does not separate from the core or receptacle must be picked for long-distance shipments when hard and firm, though well colored. The highest quality is attained by leaving the berries on the vines until fully mature, but for fresh shipments and for frozen pack it is necessary to pick the fruit while it is still firm.

Specifications for frozen-pack berries, issued in 1932 by the National Preservers' Association, include the following quality standard:

"First Quality Cold Pack Berries" shall mean that all berries are four-fifths colored, in good condition; free from tough or dried berries, free from overripe or underripe fruit; free from foreign substance, such as sand, dirt, or trash; free from hulls, caps, or stems, free from wormy, moldy, or fermented fruit." For wormy, moldy, or fermented fruit and for leaves, stems, and straw the tolerance shall not be more than $\frac{1}{2}$ per cent. The total tolerance for defects, such as poorly colored, tough, or dried berries, for overripe or green berries, for hulls, caps, or stems shall not exceed 5 per cent, including the $\frac{1}{2}$ per cent for other defects, previously mentioned.

It has been further specified that No. 1 loganberries shall be not less than 1 inch in length; No. 2 not less than $\frac{3}{4}$ inch. No. 1 red raspberries shall be not less than $\frac{9}{16}$ inch in diameter; No. 2 the same size but may be darker in color. Fresh No. 1 blackberries shall be not less than $\frac{5}{8}$ inch in diameter. Gooseberries shall be not less than $\frac{3}{8}$ inch in diameter. Where berries are intended for canning or for frozen pack these specifications should be held as a standard.

The requirements of the California Fruit, Nut, and Vegetable Standardization Act of 1931 are as follows :

[The berries] shall be mature but not overripe, shall be free from mold, decay, and insect injury which has penetrated or damaged the flesh and free from damage caused by sun, frost, bruises, disease, or other means. In order to allow for variation incident to proper grading and handling, not more than ten per cent by weight, of the berries . . . in any one container or bulk lot, may be below these requirements, but not to exceed one-half of this tolerance, or five per cent, shall be allowed for any one cause.

Basket carriers holding six or eight baskets and provided with a bale are generally used in picking berries (fig. 20, left). To avoid stooping, pickers sometimes use carriers fitted with short legs. Many workers, when picking the thorny varieties, wear gloves from which the fingers have been removed on the picking hand. Forked sticks for propping up the berry canes are often used while picking.

Currants and Gooseberries—Currants are usually harvested in two pickings. There is no danger of the fruit's becoming soft under ordinary conditions, but injury from scalding often results during a period of hot weather. The danger of loss from this cause is reduced by making two pickings. The fruit is in right condition for picking when all the berries on the cluster are red. The cluster should be picked whole, and the berries not separated from the stem, for when the berries are picked from the cluster, the entire package is moistened with the juice which escapes, and decay quickly follows.

Gooseberries are sometimes picked by holding a portion of the bush in a gloved hand and picking with the bare hand. On a large scale they are picked by stripping the leaves and fruit into a shallow box and then removing the leaves by running the entire picking through a fanning mill, which blows out the leaves and pieces of branches. As the fruit is picked while still hard and green, no injury results from this method of handling.

BERRY PACKAGES OR CONTAINERS

There are two important packages used for local shipments of berries in California. The berry chest (fig. 21, left), used extensively in central California, holds 20 drawers, and each drawer has 6 of the half-dry-pint baskets, this making a total of 120 half-dry-pint baskets to the chest. In southern California the 30-basket crate is standard (fig. 20, right). Both the chest and the crate are returnable. The 12-basket drawer or slide is used extensively in southern California and does not have to be returned. A 15-basket drawer has been used in southern California to a limited extent but is not popular. The 6-basket drawer used in the berry

chest makes handling easy in the field or in the retail market. A 20-basket crate has been used for high-top baskets in northern California but is only seen occasionally.

The legal berry baskets for bush fruits in California are the dry pint and the half dry pint. Only the half-dry-pint basket is in general use but a few blackberry growers ship in the dry-pint baskets when berry

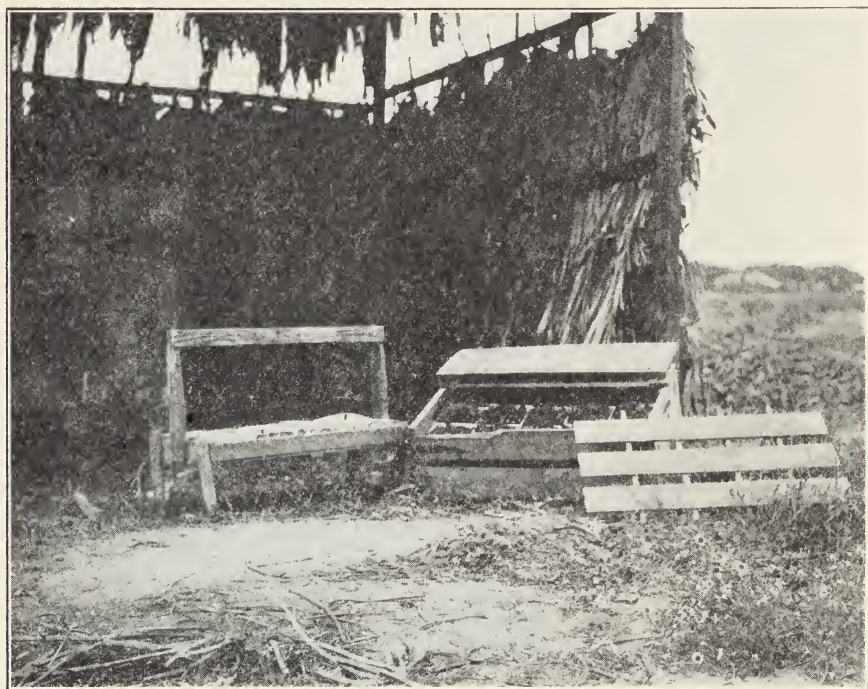


Fig. 20.—Field carrier used for picking berries, and crate containing 30 baskets, used in southern California. (From Ext. Cir. 25.)

prices are low. The half-dry-pint basket should contain 16.8 cubic inches. Both paper and wood baskets are used. The cost of tin-top wood baskets ranged from \$3.15 to \$3.25 per thousand early in 1933. Mills making the baskets usually make the most attractive price during the winter season. Metal-top wood baskets cost a little more but are generally preferred to paper.

There is no legal standard for currant or gooseberry containers. In central California currants have been shipped in grape or plum baskets holding about 5 pounds or in a shallow tray or drawer holding about 10 pounds. Gooseberries are sold in baskets, trays, or lug boxes.

For long-distance shipment of loganberries from the Watsonville district a patented 12-basket tray has been used extensively. The trays are

rabbeted or recessed at each end so they may be stacked into one large crate without any end play. Strips tacked to the ends of the trays prevent any movement during transportation. Such a snug package is ideal for long-distance shipment because it is light, well ventilated, and does away with any need of extra support.

DISTRIBUTION AND MARKETING

Hauling and Shipping Bush Fruits.—Hauling to market is now largely done by automobile truck. The various associations and companies handling fruit usually arrange to have the fruit collected at the farm or at a central shipping point. The grower places his chests or crates of berries on a loading platform (fig. 21) located at a convenient place, and the shipment is picked up by the truck which follows a route from farm to farm or from the central shipping point to the city.

Fruit for long-distance shipment must be picked in exactly the right condition, handled carefully, and precooled. Such shipments are usually handled by refrigerator express or fast passenger trains. Some varieties ship better than others. The best shippers are those which the grower knows as "dry berries," varieties which do not bruise easily or allow the juice to escape—for example, the Ranere variety of red raspberry, grown extensively in Santa Clara County and adjacent counties. Other varieties, like the Surprise, are largely limited to local markets. The Cuthbert ships fairly well. Loganberries ship reasonably well. Youngberries from central California have been shipped by express to the Los Angeles market.

A regulated flow of the berry crop to market in accordance with demand is essential for good returns. The fresh-berry trade on California markets will be of greatest importance to the ordinary commercial grower. By planting more than one variety it is possible to distribute the harvest season over several weeks. For example, in southern California the season might start with the Advance blackberry which normally begins to ripen between April 15 and April 25. In some seasons this variety may be as late as the first of May. In very early districts near the coast the first berries may ripen as early as March. The Surprise raspberry in southern California begins to ripen about May 1 and continues until June 15. The Gardena dewberry follows about May 15 to 25. The Lucretia begins to ripen about 10 days or two weeks later. The Mammoth blackberry, Cory Thornless blackberry, Crandall (Macatawa) blackberry, the loganberry, and the youngberry ripen in June and July. The Himalaya and Brainerd are very late, usually ripening in July and August.

In central California the harvest season for blackberries extends from June 1 to early October, with the heaviest pickings in July and August; for loganberries from early in June until the middle of July, with heaviest market receipts during the first three weeks of July; for raspberries from early in June until the fall months, with heaviest shipments coming from the last of June until the latter part of July. Red raspberries



Fig. 21.—Platform for loading berry chests on automobile trucks. The large berry chests at the left, containing 20 drawers with 6 baskets each, are used extensively in central California. (From Ext. Cir. 25.)

often ripen late in the season in central California so it is not uncommon to have fairly low prices in the fall as well as in June when a large part of the early crop ripens.

The same variety of berry will differ in time of ripening according to the season and the district. This is well illustrated by the youngberry. The 1932 shipments to the Los Angeles market extended from May 16 to about July 4. The peak of the southern California season was reached about June 1; 3,200 crates arrived on May 31 and 2,700 crates on June 1. Shipments from central California began to arrive on June 13 and reached their peak on June 27. From June 13 to July 4 there was an overlapping of shipments from the two districts. This extension of the

berry season on a single market can be recommended as far as the shipping costs will permit. With growers properly organized into an effective marketing association it should be possible to stabilize shipments to the local California markets.

Organization of Berry Growers.—The Central California Berry Growers' Association with headquarters in San Francisco, has been active in the six coast counties of Alameda, Santa Clara, San Mateo, Santa Cruz, Monterey, and San Benito. Southern California berry growers have been unorganized until early in 1933, when articles of incorporation for the Berry Growers' Association were prepared. The berry organizations are seeking a proper distribution of the crop so that there will be less danger of occasional market gluts at the peak of the season. Some growers prefer to sell direct to consumers, as from roadside stands. Such direct marketing is only feasible when there is a good local demand and the crop is not too large. For handling very large crops, organized marketing usually becomes a necessity.

OUTLOOK FOR BUSH FRUITS IN CALIFORNIA

The acreage devoted to bush fruits in California has continued to decline in recent years, except in the case of raspberries and youngberries. No marked change in the situation is expected unless the market improves. While California canneries packed a few berries in 1933 it is unlikely that growers will find any important outlet through canneries, because of competition with the Pacific Northwest growers, who have better yields and equally good quality. Even Oregon growers were advised in 1931 by their Experiment Station workers that "the potential production of berries in the Pacific Northwest is far in excess of present market demands." The general advice offered is that berry growers should be guided primarily by the trends in competing areas and by changes in market demand for berries and berry products.

The outlook for blackberries and dewberries is not very encouraging. Local markets for fresh blackberries and dewberries will probably continue to absorb the output from productive plantings because there is no other satisfactory outlet. Any large crop sent to the fresh market might lead to low prices and a surplus. It is unlikely that California growers of blackberries and dewberries will find any profitable outlet through canneries or barreling plants because of the low prices offered in other states where yields of blackberries average better than in California. For example, Oregon growers have been offered only about 4 cents a pound, which is hardly enough to pay for the time and money invested even where yields per acre are reasonably good.

No expansion of the loganberry acreage appears at present writing to be justified. Oregon growers in 1930 expressed the opinion that 5 cents a pound is necessary to maintain the present acreage of loganberries. California growers of loganberries and youngberries will probably require at least as great a price in order to maintain their acreage. There has been a continuous decline in plantings for several years and with the introduction of the youngberry this decline may be hastened, although the youngberry is not a complete substitute for the loganberry in respect to acidity, flavor, and appearance. Plantings with good yields should probably be maintained to take care of the present demand.

The market for youngberries started out very promisingly before 1930, but with heavy plantings in southern California there now seems to be a surplus beyond what the Los Angeles market for fresh berries can handle for about a week or ten days at the peak of the southern California season. In 1932 this occurred the latter part of May and the first week in June and about the middle of June in 1933. Trouble has occurred over the week-ends and after a holiday whenever market deliveries exceeded about 1,200 crates (30 baskets each) per day. Excess supplies will have to be disposed of to canners or processors, or else stabilization of shipments will be necessary to conform to market demands, if growers are to expect a profit. Youngberry growers of southern California are now organized so they may be able to regulate market deliveries at the peak of the season. The berries coming in from central California are enough later not to cause any surplus, unless northern plantings should greatly increase in the next few years. Central California growers are already organized to take care of their marketing problems. But with canneries packing few berries and the demand for frozen-pack berries uncertain, caution will be necessary. The youngberry is unusually well adapted for the frozen pack; growers may be able to interest processors or barrelers in taking any seasonal surplus that may develop. This is one of the problems which berry growers are now considering.

The long-time outlook for raspberries appears favorable. Prices for red raspberries have continued good and should remain satisfactory unless unreasonable plantings are made or unless serious competition from other states develops. Growers in the Pacific Northwest are putting up a large frozen pack and are selling to canners. They also ship some fresh berries to eastern markets. California raspberry growers should carefully investigate such competition before planning to increase out-of-state shipments greatly. There is a possibility that some frozen-pack raspberries might be put up in case a surplus should develop on local markets.

Plantings of currants, gooseberries, and blueberries are not promising except in a few localities near the coast in central or northern California and possibly in some of the higher mountain valleys and foothills of the state where satisfactory yields can be secured. Small plantings for home use may be justified wherever climatic conditions are favorable for good production. Unless the present low yields can be improved, returns per acre to commercial growers will probably be very discouraging.

Many new varieties of berries are being tested in California and more may be offered in the next few years. Some of these may yield better and may please consumers better. But any marked increase in the production of bush berries in California will be dependent on an increased demand. This increased demand can hardly be expected unless the price to consumers is lowered enough to compete with other popular fruits. The consumption of bush fruits per person in the western portion of the United States is exceedingly low and will probably remain low until some special appeal is discovered or brought about by advertising.

An increase in the acreage of bush berries may be expected to follow closely any high prices that may occur. But the difficulty in securing cheap labor at such times, and the disinclination of many to perform the somewhat irksome task of caring for the berry farm, may be expected to exert an influence against any long-continued period of overproduction. Controlled production accompanied by proper distribution and marketing promises fair returns to the grower with a moderate-sized farm, provided he is favorably situated and does most of the necessary work himself, aside from picking.

ACKNOWLEDGMENTS

Special acknowledgment is given to Dr. W. H. Chandler and Dr. A. H. Hendrickson of the Division of Pomology for the suggestions in preparing this circular and for their help in reviewing the manuscript. Professor E. O. Essig and Dr. Leslie Smith of the Division of Entomology and Parasitology kindly offered recommendations on the control of various insect pests. Professor Ralph Smith and Dr. B. A. Rudolph were consulted regarding berry diseases. Miss Hilda Faust, Agricultural Extension Specialist on nutrition, assisted in supplying information on the food value of berries. Professor R. L. Adams of the Division of Agricultural Economics reviewed the section on expense items for establishing a berry farm. Mr. E. W. Braun, formerly of the Agricultural Extension Service, reviewed the section on the outlook for bush fruits. Appreciation is also expressed for the valuable information supplied by berry growers and others interested in the berry industry.

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¹⁰ United States Department of Agriculture publications may be secured as references in some public libraries, or they may be purchased from the U. S. Superintendent of Documents, Washington, D. C., for the amount noted. Stamps are not accepted. University of California College of Agriculture publications may be secured free of charge as long as the supply lasts. Publications of other states are not usually available for residents of California, except as references in public libraries.

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